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CONTENTS.

Botany in England: PROFESSOR F. W. OLIVER 321

The Correspondence School—its Relation to Technical Education and some of its Results: J. J. CLARK 327

The Present Needs of the Harvard Medical School: DR. F. B. MALLORY 334

Scientific Books:—
Bailey's Text-book of Sanitary and Applied Chemistry: PROFESSOR ELLEN H. RICHARDS. *Fischer's Animal Mechanics:* T. D. *Bernthsen's Kurzes Lehrbuch der organischen Chemie:* PROFESSOR W. A. NOYES 338

Discussion and Correspondence:—
An Unusual Meteor: PROFESSOR CLEVELAND ABBE. *Some 'Definitions' of the Dyne:* HAROLD C. BARKER 340

Special Articles:—
A Peculiar Mutation of the Pine Marten: MARCUS W. LYON, JR. *An Object-finder for the Micro-projection Apparatus:* AMON B. PLOWMAN. *Helium in Natural Gas:* HAMILTON P. CADY, DAVID F. MCFARLAND. 341

Current Notes on Meteorology:—
Dr. Hann and the 'Meteorologische Zeitschrift'; Anti-trades in Central America and the West Indies; Rainfall, Temperature and Tree Growth; Cumulus Clouds over the San Francisco Fire: PROFESSOR R. DEC. WARD 344

Proposed Union of Medical Societies in London 346

Cheaper Liquid Air 346

Radium 347

Scientific Notes and News 349

University and Educational News 351

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BOTANY IN ENGLAND.[1]

THE period of twenty-five years that has elapsed since the British Association last met in this city all but includes the rise of modern botany in this country. During the middle decades of last century our botanists were preoccupied with arranging and describing the countless collections of new plants that poured in from every quarter of an expanding empire. The methods inculcated by Linnæus and the other great taxonomists of the eighteenth century had taken deep root with us and choked out all other influences. Schleiden's 'Principles of Botany,' which marked a great awakening elsewhere, failed to arouse us. The great results of Von Mohl, Hofmeister, Nägeli and so many other notable workers, which practically transformed botany, were at first without visible effect.

It was not that we were lacking in men capable of appreciating the newer work. Henfrey, Dr. Lankester (the father of our president), not to mention others, were continually bringing these results before societies, writing about them in the journals, and translating books. But the thing never caught on—it would have been surprising if it had. You may write and talk to your contemporaries to your heart's content, and leave no lasting impression. The

[1] Concluding part of the opening address of Professor F. W. Oliver, F.R.S., president of the Section of Botany, at the York meeting of the British Association for the Advancement of Science.

schools were not ready. No movement of the sort could take root without the means of enlisting the sympathies of the rising generation. It was only in the seventies that effective steps were taken to place botany on the higher platform; and the service rendered in this connection by Thistleton-Dyer and Vines is within the knowledge of us all. Like the former in London, so the latter at Cambridge aroused great enthusiasm by his admirable courses of lectures. Great service, too, was rendered by the Clarendon Press, which diffused excellent translations of the best continental text-books—a policy which it still pursues with unabated vigor, though the need of them is, I hope, less urgent now than formerly. Already at the time of the last meeting in York (1881) a select band of Englishmen were at work upon original investigations of the modern kind. The individuals who formed this little group of pioneers in their turn influenced their pupils, and so the movement spread and grew. It would be premature to enter fully into this phase of the movement, so I will pass on with the remark that modern botany was singularly fortunate in its early exponents.

Whenever the history of botany in England comes to be written, one very important event will have to be chronicled. This is the foundation of the Jodrell Laboratory at Kew, which dates from the year 1876. Hidden away in a corner of the gardens this unpretentious appendage of the Kew establishment has played a leading part in the work of the last twenty-five years. Here you were free to pursue your investigations with the whole resources of the gardens at your command. I suppose there is hardly a botanist in the country who has not, at some time or other, availed himself of these facilities, and who does not cherish the happiest memories of the time he may have spent there. Certainly Jodrell displayed rare sagacity in his benefactions, which included, in addition to the laboratory that bears his name, the endowments of the chairs of animal physiology and zoology at University College, London.

Sir William Thistleton-Dyer, who has so recently retired from the directorship of Kew, had every means of knowing that his happy inspiration of founding a laboratory at Kew was a most fertile one. It would not be surprising if the future were to show that of the many changes inaugurated during his period of service this departure should prove by far the most fruitful.

Another incident belonging to the early days ought not to be overlooked: I refer to the notable concourse of continental and American botanists at the Manchester meeting of the British Association in 1887. The genuine interest which they evinced in our budding efforts and the friendly encouragement extended to us on that occasion certainly left an abiding impression and cheered us on our way.

We are not forgetful of our obligations. We regard them in the light of a sort of funded debt on which it is at once a pleasure and a duty to pay interest. The dividends, I believe, are steadily increasing—a happy result which I am confident will be maintained.

But I should be lacking in my duty did I permit the impression to remain that botany is anything but a sturdy and natural growth among us. The awakening, no doubt, came late, and at first we were influenced from without in the subject-matter of our investigations. But many lines of work have gradually opened out, whilst fruitful new departures and important advances have not been wanting. We still lean a little heavily on the morphological side, and our most urgent need lies in the direction of physiology. As chemists and physicists realize more fully the possibilities of

the 'botanical Hinterland,' one may expect the conventional frontier to become obliterated. As Mr. F. F. Blackman has pointed out in a recent interesting contribution,[2] the chemist's point of view has undergone a change with the growth of the science of physical chemistry, and is now much more in line with that of the biologist than was formerly the case. This natural passage from the problems of the one to those of the other should be the means of attracting into our body recruits possessing the necessary chemical equipment to attack physiological problems.

As the position gains strength on the physiological side, it will become possible to render more effective service to agriculture and other branches of economic botany.

This is of importance for a variety of reasons. Among others it will bring public support and recognition which will be all for good, and it will provide an outlet for our students. It will also afford unrivaled opportunities for experiments on the large scale. Even should economic conditions, which compel us to import every vegetable product, continue to prevail in this country, this will not be so in the colonies. As time goes on, one may reasonably expect an increasing demand for trained botanists, ready to turn their hands to a great variety of economic problems.

From this rough sketch we see that the prevailing school of botany has arisen very independently of that which preceded it. The discontinuity between them you might almost call abrupt. All through the middle parts of the last century we were so busy amassing and classifying plants that the great questions of botanical policy were left to solve themselves. Great herbaria became of the order of things: they received government recognition, and they continue their work apart. Those who built up these great collections neglected to convince the schools of the importance of training a generation of botanists that would use them. The schools were free, and they have gone their own way, and that way does not lie in the direction of the systematic botany of the herbarium. So long as this tendency prevails the herbaria must languish. When I say languish, I do not mean that they will suffer from inefficient administration—their efficiency probably has never been greater than at the present time. But the effort involved in their construction and upkeep is altogether disproportionate to any service to which they are put. Work, of course, comes out of them; it is no question of the devotion or ability of individuals. It is the general position, the isolation of systematic botany, to which attention should be directed with a view to its alleviation.

If things are left to take their course there is the fear of atrophy through disuse. The operation of the ordinary economic laws will no doubt serve to fill vacancies on the staff as they arise, but the best men will be reluctant to enter. Of course the pendulum may begin to swing the other way, though no indication of such a change is yet apparent.

Let us now attempt an analysis of some of the causes which have led to this condition of affairs.

In the first place, our two national herbaria (Kew and the British Museum) stand apart from the ordinary botanical current. They are administered, the one as a portion of the Kew establishment under the board of agriculture, the other as a department of the British Museum under a board of trustees. Neither has any connection, direct or indirect, with any university organization. The keepers and

[2] 'Incipient Vitality,' *New Phytologist*, Vol. V., p. 22.

assistants as such have no educational functions allotted them; I mean positions in these herbaria carry no teaching duties with them. There are no facilities for teaching; there are no students. No machinery exists for training recruits or for interesting anybody in the ideals and methods of systematic botany. A recent event illustrates my meaning better than any words. My friend Dr. Rendle accepted the keepership of the botanical department at the British Museum a few months ago. Previously, as assistant, he had held a lectureship at a London college. One of the first consequences of his new appointment was his retirement from the teaching post. Now that was bad. Under the conditions which one would like to see there would have been no resignation. On the contrary, the keepership should have entitled Dr. Rendle to promotion to a full professorship. I do not mean a great post, with elementary classes, organization, and so on, but one in which he would be occupied with his own branch, giving a course for advanced students, let us say, once a year during the summer months. Nor is that all. Such are the vagaries of our university organization in London that we run some risk of losing Dr. Rendle from the board of studies in botany. Automatically he ceases to be a 'recognized teacher,' and unless some loophole can be found the connection will be severed.

Next we come to the question of routine duties. These are heavy in herbaria, and must include a great many that could be satisfactorily discharged by handy attendants. As in the case of those who work in laboratories, half a man's time should be at his own disposal for original investigations. It is important, for a variety of reasons, that the members of the staff should take a leading part in advancing systematic botany.

Then there is another way in which a great economy could be effected in effort, time and money. This is the transfer of the collections and staff of the botanical department from the Museum to Kew. This is a very old proposal, first seriously entertained some fifty years ago after the death of Robert Brown. There must be endless files of reports and blue books in official pigeon-holes dealing with this question. The most recent report of a departmental committee is known to all interested in the matter. From the character of the evidence tendered it is not surprising that no action has been taken. I am at a loss to find any adequate reason for the continuance of two separate herbaria. It has been urged, no doubt, that botany would suffer if unrepresented in the museum collections at South Kensington, and that the dried collections and herbarium staff are a necessary adjunct to the maintenance of a botanical museum. But there is little force in the contention. The specimens that go to make a herbarium are not proper subject-matter for museum display; nor is there anything about herbarium work which intrinsically fits the staff to engage in the arrangement of museum cases. The function of a botanical museum is to interest, stimulate and attract. It should convey an idea of the current state of the science, and particularly of the problems that are to the front, in so far as it is possible to illustrate them. It requires a curator with imagination and ideas, as well as an all-round knowledge of his subject. He must also be an artist. Logically there is no reason why a museum should be part of the same organization as systematic collections. There is, indeed, a danger of making the museum too exhaustive. I am speaking, of course, of a teaching museum, which belongs really to the province of a university, or university extension if you

like. Systematic collections kept exposed under glass are luxuries. All the world agrees that the museum side is admirably done at South Kensington, and most people attribute this success to the systematic element which is paramount behind the scenes. But, as we have seen, this is a fallacy, and the 'museum argument' for keeping the herbarium at South Kensington may be ignored.

By the fusion of the herbaria at Kew one would look for increased economy and efficiency, more time for original work as distinguished from routine duties, and a more complete specialization.

We now approach another aspect of the question. Much has been said on the value of anatomical characters in classification, and it is pretty generally conceded that they ought to be taken into consideration, though, like other characters, they are beset with their own special difficulties. As Dr. Scott—who has always urged their importance—says:[3]

> Our knowledge of the comparative anatomy of plants, from this point of view, is still very backward, and it is quite possible that the introduction of such characters into the ordinary work of the herbarium may be premature; certainly it must be conducted with the greatest judgment and caution. We have not yet got our data, but every encouragement should be given to the collection of such data, so that our classification in the future may rest on the broad foundation of a comparison of the entire structure of plants.

This passage was written ten years ago and we are still awaiting its realization.

It is perfectly true that in the case of a recent proposal to found a new natural order of flowering plants anatomical characters find due consideration; still, on the whole, we are content to rely on the traditional methods that have been transmitted from Linnæus and the old taxonomists. So much material is always passing under the hands of our systematists that they can not devote the time for the elaboration of a fresh method. In particular there are the new things which require docketing and provisional description. Circumstances, as ever, place obstacles in our way and tend to make us unprogressive.

Now it seems to be of the first importance that reform should come from within; that these problems, which are systematists' problems, should be solved by taxonomic specialists.

I am sanguine enough to believe that much might be done by a redistribution of duties, especially if this were accompanied by the fusion of the great herbaria, to which reference has already been made. But the greatest hope, I think, must lie in the possibility of some form of alliance or understanding between the authorities responsible for the administration of the herbaria on the one hand and the local university on the other. For directly you give the keepers or assistants in the former a status in the latter, you place at the disposal of the systematists a considerable supply of recruits in the form of advanced students possessing the requisite training to carry out investigations under direction. And if this be true of the herbaria, it holds equally in all the branches of knowledge represented in the National Museum. Really I fancy our museum is rather anomalous in its isolation. I am confident that any understanding or arrangement that might be reached would be attended with great reciprocal advantage. Nor am I speaking without some data before me. The movement towards a closer relation between the museum and the university has already entered the experimental stage. For on several occasions during the last few years members of the museum staff, from more than one department, have

[3] D. H. Scott, presidential address, Section K, British Association for the Advancement of Science (1896).

given courses of lectures in connection with the university schemes of advanced study. From all I hear, the experiment may be regarded as distinctly encouraging.

Before leaving this subject it may be appropriate to recall that the English edition of Solereder's great work on systematic plant-anatomy is rapidly approaching completion, and should be available very shortly. Its appearance can not fail once more to arouse discussion as to the importance of anatomical characters. I hope the result produced may reward the devotion and labor with which Mr. L. A. Boodle and Dr. Fritsch have carried out their task.

In another and even more fundamental branch of systematic work the future seems brimful of promise. We are beginning to recognize that a vast number of the species of the systematist have no correspondence with the real units of nature, but are to be regarded rather as subjective groups or plexuses composed of closely similar units which possess a wide range of overlapping variability. That such might be the case was apparent to Linnæus, but the proof depends on the application of precise methods of analysis.

In the year 1870 our great taxonomist Bentham happened to meet Nägeli at Munich, and, as we find recorded in Mr. Daydon Jackson's interesting life, "had half an hour's conversation with him on his views that in systematic botany it is better to spend years in studying thoroughly two or three species, and thus really to contribute essentially to the science, than to review generally floras and groups of species." Bentham does not appear to have been convinced, for his comment runs: 'He is otherwise, evidently, a man of great ability and zeal, and a constant and hard worker.' At the time of this interview Bentham was seventy years old, Nägeli being seventeen years his junior. The views of the latter are now bearing fruit, as we see in the important results already obtained by de Vries and others, who are following the methods of experimental cultivation with so much success.

The supposed slowness of change has been a difficulty to many. This was one of the 'lions' left by Darwin in the way, and it has driven back many a 'Timorous' and 'Mistrust.' Now, as we are gradually perceiving, it is only a chained lion after all; a thing to avoid and pass by. The detection of the origin of species and varieties by sudden mutation opens out new vistas to the systematist, and along these he will pursue his way. It will take many years of arduous work, this reinvestigation of the species question. The collections of our herbaria form the provisional sorting-out from which we must start afresh. In the long run it may be that our present collections will prove obsolete, but that will not deter us. The scrap-heap is the sign and measure of all progress.

The garden thus becomes an instrument of supreme importance in conjunction with the herbarium, and that is another reason for the transfer of South Kensington to Kew. The resources of the latter could then be directed more fully than ever to the advancement of scientific botany, and the gardens would be revealed in a new light. For the operations and results of experimental inquiries would form a new feature, very acceptable to the specialist and public alike. And, as I am on the subject, it may not be out of place to remark that we all look forward eagerly to the time when the multifarious activities of Kew will permit the development of other features of which traces are already discernible. The arrangement of the living collections is at present based largely on horticultural convenience, geographic origin and systematic affinity, happily sub-

ordinated to an artistic or decorative treatment. In time we shall go further than that and attempt in some degree to reflect current botanical ideas in the grouping of our plants. Let me illustrate my meaning by a good example. The succulent house is generally conceded to form one of the most interesting and stimulating exhibits to be seen at Kew—not merely from the weird and grotesque forms assumed by the individual plants, but chiefly because here you have assembled together plants of the most varied affinity having the common bond of similar adaptations to a like type of environment. The principles that underlie the arrangement of the best sort of museum may be applied with advantage in the case of a garden, and with tenfold effect; for is not a live dandelion better than a dead *Welwitschia?* This feature, introduced as it would be with moderation and discretion, would immensely enhance the value of the gardens both to the student and general visitor.

But to return from this digression: on the whole the time seems ripe for the new departure. Fresh lines are opening up in systematic botany that call for special provision. Now it was evident from the circumstances of the botanical renaissance twenty-five years ago that when it acquired strength some readjustment between the old and the new would have to be made. The thing was inevitable. The administrative acts of recent years all point in the same direction. The founding of the Jodrell Laboratory, the enhanced efficiency of the gardens, the great extension of the herbarium building, all help to pave the way. But more is wanted. Reference has been made to the advantages that would attend the migration from the Natural History Museum. But it is most important of all to devise a mechanism for securing a flow of recruits to carry on the work. This would follow in the wake of a *rapprochement* with the schools on the lines already sketched out. Difficulties, no doubt, will be encountered in the initial stages of a reorganization, but these are inseparable from our bureaucratic system. A very hopeful sign is the readiness which the government has shown in instituting inquiries in the past. That nothing has come of them may be attributed primarily to the attitude of botanists themselves. If they can unite on any common policy, there should be no serious delay in giving it effect.

THE CORRESPONDENCE SCHOOL—ITS RELATION TO TECHNICAL EDUCATION AND SOME OF ITS RESULTS.[1]

AT the 1899 meeting of the Society for Promotion of Engineering Education, held at Columbus, Ohio, a paper was presented by Professor Edgar Marburg, entitled 'The Correspondence School in Technical Education.'[2] This paper aroused considerable interest, and was discussed quite generally, with the result that a committee on industrial education was appointed, of which Professor J. B. Johnson was chairman. This committee reported at the New York meeting in the following year.[3]

At the time Professor Marburg prepared his paper the total number of students enrolled in the International Correspondence Schools was about 80,000, and at the time the committee made its report the number of students enrolled was about 181,000. It was impossible at that time to furnish reliable figures in regard to the work being

[1] Read at the Ithaca meeting of the American Association for the Advancement of Science, June 30, 1906, before Section D, Mechanical Science and Engineering.

[2] *Proceedings of the Society for the Promotion of Engineering Education*, Vol. VII., p. 80.

[3] *Proceedings of the Society for the Promotion of Engineering Education*, Vol. VIII., p. 28.

accomplished; consequently, both Professor Marburg's paper and the report of the committee were, in some respects, unsatisfactory and unjust to the correspondence school.

In order that you may understand several of the facts that I am about to bring to your attention, it will be well to consider the enrolment figures for the various years since the organization of the International Correspondence Schools.

From October 1, 1891, to December 31, 1893, the total number of students enrolled was	3,105
The number of new students enrolled to December 31, 1894	2,509
The number of new students enrolled to December 31, 1895	4,491
The number of new students enrolled to December 31, 1896	6,530
The number of new students enrolled to December 31, 1897	13,677
The number of new students enrolled to December 31, 1898	38,572
The number of new students enrolled to December 31, 1899	71,885

Since December 31, 1899, we have been enrolling students at the rate of more than 100,000 per year, the total number to and including June 27, 1906, being 902,906.

It will be noted that up to and including the enrolment for 1897, the increase in the number of students was comparatively even. After this date, however, the number of students enrolled increased very remarkably. There are two reasons for this sudden increase in the enrolment. Previous to January 1, 1898, the students received their text-books in the form of paper-covered pamphlets, averaging about fifty pages each, and these were sent only one at a time to each student as he progressed with his studies. The result was that if a student failed to complete his course, he had on hand not more than two instruction papers in advance of the last one he had studied. This tended to create great dissatisfaction, and, to overcome it, we reprinted the entire text of the courses, and sent to every student, at the time of his enrolment, a set of what we term bound volumes. These volumes contained every thing that the student would receive in connection with his course of instruction, and if he failed to complete the course he had his bound volumes at any rate, and could continue studying by himself, if he so desired. This feature resulted in a great increase in the number of students. Further, previous to the latter part of 1897, the students were obtained solely by newspaper and magazine advertising. They were all enrolled through the mails and no pressure was applied to induce them to become students. About the time we began printing bound volumes we began to organize a force of solicitors. These solicitors interviewed the prospective student personally, and naturally did everything they could to increase the number of students. The result is shown by the figures above quoted.

In 1899 and 1900, the number of new students enrolled was so great, relatively speaking, that it was impossible to furnish any definite figures to the committee or to Professor Marburg to substantiate our claims, and we ourselves could not predict definitely what the outcome would be. The enrolment has been comparatively steady during the past seven years, and we are now better able to present to the society facts and statistics that will enable you to judge of the work we are doing. At the same time, we can not give you full and complete information in regard to the benefits derived by our students. We have received hundreds and thousands of letters from students who have never sent in any work at all to be examined and corrected, or who have sent in work on only one subject—as for example, arithmetic—in which letters they have stated that they

have derived great benefit from their courses. On inquiry we found that these students had studied from their bound volumes, and that the text had been so carefully prepared that they did not desire to go to the trouble of writing out the answers to the examination questions; and not caring whether or not they obtained a diploma or certificate, they never sent in any work.

Before pursuing this subject further, it will be well to consider the character of the courses we offer, and the reason why we offer so many different courses. Our system of education is based on an idea that is almost directly opposite the views held by the regular schools and colleges. The regular technical school or college aims to educate a man broadly; our aim, on the contrary, is to educate him only along some particular line. The college demands that a student shall have certain educational qualifications to enter it, and that all students study for approximately the same length of time, and when they have finished their courses they are supposed to be qualified to enter any one of a number of branches in some particular profession. We, on the contrary, are aiming to make our courses fit the particular needs of the student who takes them. If a student is employed as a helper in some shop, and desires to become a stationary engineer or draftsman, or bookkeeper, or to follow any other special branch of industry, we can offer him a course that will fit him for the particular position he has in mind. Such a student does not wish or desire to be forced to study anything that is not strictly necessary for him to learn in order to fill the position he is aiming at. Consequently, without citing other instances, it may be stated that every one of our courses, with a few exceptions, perhaps, is a special course. If a person desires to take up bridge engineering, and does not wish to learn the other branches of civil engineering, we offer him our bridge engineering course. He studies only those subjects that are necessary for him to know in order for him to understand everything we teach in regard to bridge engineering. If the person wishes to study stenography, we offer him our stenographic course. If, however, he wishes to take a course that would correspond to a course in a business college, we offer him what we term our complete commercial course, which includes bookkeeping, stenography and other subjects. If a student desires to study mechanical drawing, and does not wish to take our mechanical or mechanical engineering course, we will offer him our course in mechanical drawing, and will not compel him to study any other subject. There are many persons who already have a good knowledge of mathematics and who have a good general education. They find it necessary to have some knowledge of mechanical drawing, but do not wish to study any other subject. Such a person can take our mechanical-drawing course and learn the latest and best methods in use in the leading drafting rooms of the country.

Considered from a pedagogical standpoint, our methods are a distinct departure from any that have previously been tried. What has been stated here with regard to the methods of the International Correspondence Schools, applies with equal force to a number of other correspondence schools. These remarks do not apply to all correspondence schools, however, for the reason that some of them are conducted along an entirely different line. Attempts have been made to conduct correspondence schools by means of what may be termed the regular text-books such as are used in the ordinary school or college. Their plan

is to purchase these text-books, direct the student to study a certain number of pages or chapters and then answer a set of questions. The student's answers are corrected and returned to him, and if he desires to be informed regarding anything not clearly explained in the text, he may write to the schools and obtain the information desired. He proceeds in this way until he has finished the particular text-book he is studying. Such schools, however, have always failed, or at any rate have made very little progress, for the reason that the ordinary text-book is not adapted to the use of a person studying by himself. Another method is that in use by the University of Chicago. The student takes a regular college course, but does a part of the work at home. He can not get his degree, however, without taking about half the course in residence. This plan offers very few advantages over taking a college course in the regular manner. The student must have the same preparation and must do the same amount of work as any other student taking the same course or subject. The only requirement necessary to become a student of the International Correspondence Schools is ability to read the English language and to write it sufficiently well to be understood. Sometimes even this requirement is not fulfilled, as the student will get some one else to write his answers to the examination questions for him, from dictation. This is especially true of students speaking some language other than English. A case came up only a short time ago of a German who was unable to write English, but who induced his wife to translate the text matter to him. He dictated the answers to the examination questions, which she wrote down, and his work was corrected by our instruction department in the usual way. This is not an isolated case, but is one that occurs with considerable frequency among such students.

Inasmuch as nearly every student has a definite object in view when he takes a course, he naturally objects to anything that will delay him in obtaining the knowledge he desires. As a consequence, we frequently have several text-books treating the same subject. In some cases the text-books differ quite materially both in the amount of ground covered and in the treatment; in other cases they differ very slightly. For example, take the subject of arithmetic. We have a very complete arithmetic that is used in our English branches, teachers' and commercial courses, while for our technical courses the arithmetics are all of about the same size; they may differ slightly in the methods of treatment, but principally in the fact that the examples and illustrative citations, etc., relate to matters with which the student is supposed to be concerned in connection with his course of study. For example: in the arithmetic used in the school of mines, the examples relate to matters pertaining to mining. Another arithmetic—very similar, but having different examples and illustrative citations—is used for the courses in the school of metallurgy. This may appear to be stretching the point considerably, but our chief aim is to keep the student interested in his work and to teach him something bearing directly on the course he is taking in connection with the study of every subject in that course.

As to the results we have accomplished, it is, as before stated, impossible to furnish exact figures. Many students enrol for the purpose of studying certain subjects that will enable them to pass an examination, such as for a license for mine foreman, for engineer, etc. They do not care whether they complete a course or not, pro-

vided they get the information they need in order to pass the examination. Quite a large number of students taking our courses in marine engineering never send in any work at all. They simply take their bound volumes, study from them, pass the examination, and get their license for one of the different grades of engineer. Several years ago, the writer had considerable correspondence with the assistant foreman of the boiler department of the Richmond Locomotive Works. He was very enthusiastic regarding his work, and organized a class of about thirty-five persons employed in the boiler department, most of whom enrolled with us for our sheet-metal pattern drafting course. The superintendent and other officials of the company took great interest in his work, and furnished a room where the class could meet, and furnished desks, tables and other material, and encouraged the men generally in connection with their courses of study. The results, according to the assistant foreman, were extremely satisfactory. However, he did not furnish me with the names of any of the class until about two years after the correspondence was begun. I looked up the record of these students, and found that not a single one of them had ever sent in any work to us for correction. At the same time they were getting great benefit from their courses, and were entirely satisfied with them.

A careful examination of the records of a large number of students, for a number of years, indicates that about 60 per cent. of them send in one or more pieces of work. An examination of the records of our accounting department shows that about two thirds of the students pay in full for their courses. These facts force us to the conclusion that if a student does not pay, he does not study. There is no connection between the instruction department and the accounting department. Any student who sends in work on a paper will have his work corrected, and will have any questions answered that he may send us, regardless of whether he has paid for his course or whether he is a delinquent. At the same time, it is a fact that if a student does not pay, he does not study; while, if he does pay, as a rule, he does at least a certain amount of studying. Therefore, while our present total enrolment is a little over 900,000, it is not fair to count the actual number of students as being over about 60 per cent. of this, or about 540,000. From the figures and statistics prepared last month, we estimated that 533,000 students had sent in work on the examination questions of one or more instruction papers. From June 1, 1905, to May 31, 1906, the work on the examination questions of 517,849 instruction papers was corrected; 192,739 drawings were corrected; and 6,364 phonograph records, made by students in our language courses, were received and examined. The total number of pieces of work during this period, received from students, was, therefore, 716,952.

We compiled, about a year ago, a book giving the names, addresses and records of students who had completed about one third or more of their courses. There was excluded from this list those students taking a single subject, such as arithmetic, algebra, bookkeeping, etc., and also all the students in our school of electrotherapeutics—a total altogether of 40,261 names. The average enrolment during the period when the names were being taken off was 798,960. Hence, the number of students, living and dead, who might have been included in the book was 758,700. Taking 60 per cent. of these as active students, the number to be so counted is 455,220. The

number of names included in the book is 75,774, which is about 16.6 per cent. of the number of active students. That is, 16.6 per cent. of the number of active students have completed one third or more of their courses, as shown by our records. The number of students who have entirely completed their courses, passed their final examination and been awarded a certificate or diploma is 12,143 (up to and including June 27, 1906), or about 2.6 per cent. of the total number of active students. Although this percentage may appear low, it should be borne in mind that it will greatly increase from now on. Instead of the schools being fifteen years old, they are really only about eight or nine years old, as measured by the bulk of the enrolments. A larger proportion of students are completing their courses now than at any time in the past. And in consequence of the exceedingly large enrolment at the present time, the number of graduates will increase very materially in the next few years.

Between February 7 and April 21 we issued over 600 diplomas, an average of 240 per month. The average for the same period next year will exceed this, and may average as high as 300 per month. In consequence of a falling off in the amount of work received during the hot weather, this average will not be maintained for the whole year; but it is safe to assume that between now and this time next year, at least 2,700 diplomas will be issued. This number will be increased during the following year. The percentage of increase in the number of students receiving diplomas will be far greater than in the number of new students enrolling. This conclusion is justified by the following fact: The book before referred to which contains the names and addresses of over 75,000 students is the second edition, and was compiled between May 16 and August 9, 1905. During this period, the average enrolment was 798,960. The first edition of the book was compiled between January 18 and March 17, 1904, and the average enrolment during that period was 642,378. It was previously shown that 16.6 per cent. of the number of active students was included in the second edition of the book. I have no figures to show the exact number of names excluded corresponding to the 40,261 that were thrown out in making the previous estimate, but based on the number of students enrolled during the period that the first edition was being compiled, the number to be excluded would be 32,370. The number of names, therefore, considered in connection with the compilation of the first edition, was 610,000. Hence, the number of active students at that time would be 60 per cent. of this, or 366,000. The number of names given in the first edition was 54,500, or 14.9 per cent. of the number of active students. In the short space of sixteen months the number of persons who had become eligible to have their names inserted in the book had increased 1.7 per cent. This is a remarkable showing, and we have every reason to expect that the number of students completing their courses will increase in the same or a greater proportion.

Some of the reasons why students do not complete their courses of study have been mentioned above. It may be of interest to consider other reasons why they fail to complete their courses. As a rule, if a student has only his own inclination to induce him to devote his spare time to obtaining an education, he feels the need of an education and knows the benefit it will be to him to possess it. At the same time, most persons do not possess sufficient grit and determination to persist in the line of work they have laid out for themselves, especially when they receive no

special encouragement to do so. We do all we can to encourage the student, both by means of letters and by having our agents call on them. But there are many other influences that tend to discourage a student and to induce him to drop his course. Many students are obliged to stop studying on account of being forced to work very long hours and not having the time. Other students have an idea at the time they enrol that it will be a comparatively easy matter to study the course, and they become discouraged when they find they must work hard in order to understand the subject. Such students either do not begin to study, or else they cease studying almost as soon as they enrol.

A large proportion of our students are not only ignorant of the subject studied, but are also ignorant of *how* to study, that is, they have formed no habit of this kind, and it is necessary for us to teach them how to study, as well as the subject they do study. A large number have enrolled simply for the purpose of securing the textbooks, as these are not for sale and can be obtained in no other way. Some enrol because their friends are enrolled. At the same time, when they receive their textbooks and look them over, they become discouraged and never make any attempt to study. Some students may start in and work very well during the winter months and early spring, but during the summer months they stop for various reasons, perhaps temporarily; but later, when the weather has become cool again they have laid aside their enthusiasm and do not resume, or, if they do, the attempt is spasmodic, and the studies are soon abandoned.

We have absolutely no way of compelling a student to study. We can not threaten him with suspension or expulsion. We have no inducement that we can offer him beyond prizes, and these do not seem to produce the desired effect; and the student himself frequently has direct encouragement to give up his studies, by reason of adverse criticism of his relatives and friends.

A considerable number of students may cease studying for a long time—several years in fact—and then begin again, and go on with their courses. Quite a number of students have objected to doing the work we require of them, saying they did not have the time, and stopped sending work on this account. We know of one student who finished all the work in our mechanical course (which we usually estimate will require about three years to complete), with the exception of one of the papers on machine design. This student did good work, and received very high marks. At the same time, he would not complete the subject of machine design, because, he said, he did not have time to make the drawings that we required in connection with these papers. His course was of great benefit to him, and when we heard from him last he was superintendent of a large power plant, and was receiving a very good salary. On account, however, of his not having conformed to our requirements, we were unable to give him a diploma, although he had actually completed the entire work of the course with the exception of this one paper. This is by no means an isolated case, but it is one that has occurred with considerable frequency. In some cases, a student will not complete a course for the reason that it does not contain, in his opinion, as much on certain subjects as he thinks he should receive, and he does not care to study the course for the educational features only.

When we began to teach we did not know what the result of the experiment would be; and, furthermore, we did not have the demand for such a wide range of

information on certain subjects as we have now. During the last three or four years we have been very busy in rewriting all of our older courses. These new courses will cover the subjects more completely than the older ones did, and there will be a larger number of subjects than were included in the former courses. Inasmuch as the new courses will meet the demands of our students better than the old ones did, we expect that there will be a great increase in the number of students finishing such courses, or, at any rate, in the number of students studying a part or all of the courses.

J. J. Clark.

THE PRESENT NEEDS OF THE HARVARD MEDICAL SCHOOL.[1]

Every one who has visited the new buildings on Longwood Avenue must feel that, so far as spacious and well-lighted laboratories are concerned, the Harvard Medical School has all the laboratory space which it will require for many years to come. What it needs now, so far as these laboratory buildings are concerned, is sufficient endowment to equip, man and run them in a manner commensurate with the laboratory opportunities afforded. The school has at the present time but a small endowment fund. A much larger one is necessary, because it is becoming more and more difficult every year to induce capable men to enter the laboratory branches of medicine. This failure to take up laboratory work as a profession is due chiefly to the salaries, which, in consequence of the greatly increased cost of living and the greater returns offered by clinical branches of medicine or by business, have become entirely inadequate. No man can live in a manner becoming the position on the salaries now paid in the laboratory departments.

[1] Read before the Harvard Medical Alumni Association at its annual meeting, June 26, 1906.

The laboratory departments have, however, this advantage over the clinical departments. They have the laboratories and so can call the ablest men from any part of the world to work and teach in them. There is nothing to prevent these departments from attaining the highest rank except a lack of endowment sufficient to attract the best men and to provide funds for necessary expenses. With this provision the best results, both as regards the education of students who are to practise in the community, as regards men trained to become the medical teachers of the future, and as regards advancing medical knowledge and investigation, can be produced.

Much as adequate endowment for the laboratory departments is needed, however, lack of endowment for these departments is not the greatest need of the school at the present time. First-class laboratory departments alone will never make a great medical school. The first function of a medical school is to turn out thoroughly trained practitioners of medicine, and to do that the clinical departments must have opportunities equal to or even greater than the laboratory departments. This is not the case at present. The clinical teachers labor under great disadvantages, owing to the fact that the medical school does not have a hospital of its own and with possibly one exception has no power of appointment of clinical men in a hospital. Consequently the clinical instructors have to do their teaching in the various hospitals of Boston, which all are under different boards of management. These boards are entirely independent of the school and some of them are little inclined to cooperate with it. The resulting difficulties, which most of the clinical teachers have to contend with, are short terms of hospital service; variability in the time of year of hospital services, especially for the younger men; and the inability of the heads of departments to

select their teaching assistants in the hospitals.

In consequence of the short terms of service in the hospitals (usually four months) the clinical teachers do not have patients under their own control throughout the school year. As a result of this condition two and often three men are needed to give the same amount of instruction that is given by one man in the laboratory departments, *i. e.*, teach the eight months of the school year. As a result of the large number of men necessarily appointed by the school under these conditions the value of a teaching position is much diminished, because the salary which can be paid to each instructor is exceedingly small and because the indirect pay received in consequence of connection with the school is by no means so great as it used to be when the relative number of instructors was much less than at present.

The months during which a man is on duty in a hospital vary from year to year. Only the older clinicians are reasonably sure of certain months. A death or a resignation may cause a shift of the time of service for several men on the medical or surgical side of a hospital. On this account it is difficult for the heads of the clinical departments to plan in detail their course of instruction for the school year and for the summer. These difficulties hold in an even more marked degree for their subordinates.

Unless the heads of the clinical departments in the school are also heads of the clinical services in the hospitals they can not choose their hospital assistants, and even when they are heads of clinical services they do not have an entirely free choice; that is, it is impossible for them to select and use on their services the men best qualified to teach. They must take as their assistants those men who fall to their service by the method of assignment at present employed. Under this condition of affairs they may have as assistants men not interested in teaching or with little or no ability in that direction. Moreover, as these younger assistants on a service change from year to year, it is impossible to have a thoroughly organized, trained and permanent teaching staff.

Some of these difficulties could be eliminated by making the services continuous, as is already the case at some of the hospitals, but other difficulties are inherent in the principle on which almost all hospitals in this country are run, namely, the selection of local men only to serve on their staffs. This leads me to speak of the most vital defect which now exists in the clinical departments of the Harvard Medical School. It is the extremely limited field of choice of clinical teachers.

Since the school has practically no power of nomination or of appointment in the hospitals of Boston, it must appoint as its clinical teachers men who already hold hospital positions. The hospitals select their men from the vicinity of the city of Boston only. The result is that the hospitals of Boston dictate all the clinical appointments in the Harvard Medical School and thereby limit the choice of all its clinical teachers to Boston.

Boston is altogether too small a field from which always to obtain the best teachers. No other departments in the university or in the medical school are thus limited. All except the clinical departments are able to select from any part of the country the man who is judged best fitted for a teaching position which becomes vacant.

The number of desirable clinical teachers is still further limited in two ways, by lack of teaching ability on the part of many who receive appointment to hospital staffs,

and by promotion in hospitals on the basis of seniority only. Hospitals for the most part select the men on their staffs on the basis of their ability as practitioners of medicine, not on their ability as teachers and investigators. As a result many hospital men are not desirable as teachers or are used with detriment to the instruction. Moreover, hospitals usually select men rather early in their careers, before they have shown whether or not they possess any marked ability as teachers or investigators. The clinical men once appointed are advanced almost invariably on the basis of seniority, so that in time every man becomes the head of a clinical service. This basis of promotion may put hospital services in the control of men uninterested in teaching or inefficient in their work. There is no method of advancing rapidly the strong man with ability as a clinician, teacher and investigator, or of weeding out the inefficient man. University development, however, is based on the vital principle of selecting the most capable young men obtainable anywhere and developing them rapidly to the limit of their capacity. As a result of this present policy of promotion in hospitals the school is sometimes obliged to select an inefficient man because he is the head of a clinic and neglect a capable young man who is subordinate to him.

The result of this marked limitation of the field of selection of clinical instructors is that the clinical teachers of the school are not always of the high grade desirable and otherwise obtainable, and the broadening influence due to the introduction of men with other standards and ideals from other parts of the country is prevented.

I do not deny in the least that the clinical teachers of Harvard have always held a high rank and that many of them have made valuable contributions to medical knowledge. I only wish to point out that through circumstances over which the clinical men themselves have no control the school is unable to call to its service the exceptional clinical man from outside of Boston and put him in charge of patients. The reason of this condition of affairs is that the school has always been a parasite on the clinical men and indirectly through them on the hospitals for its clinical teaching; *i. e.*, while it has furnished its laboratory men with laboratory space and equipment, it has not provided its clinical men with wards and patients. It is only fair to add, however, that this teaching has cost the hospitals nothing and in many ways has been of advantage to them.

The medical school of the present day is no longer a place to train men solely for the business of the practise of medicine, but has become a technical school embracing many branches of science. As teachers of these different branches, trained men are needed, just as in any other technical school, *e. g.*, of engineering. In the clinical departments of most of the medical schools in this country the clinical teachers necessarily have had to make teaching a secondary part of their vocation. They have had to seek private practise in order to make a living. There have been open to clinical men no teaching positions which paid salaries large enough to enable men to live suitably and comfortably on their salaries alone; hence there has been no incentive for a man to fit himself for such a position. The only way in which a man could become a clinical teacher was by obtaining a hospital position.

At present there exists in most hospitals in this country no method for the thorough training of young men who wish to become clinical teachers. A hospital interneship is not a sufficiently long experience, but it is all that is possible at present. Under

existing conditions, after their early hospital training, young clinical men are compelled to devote their energies to earning a living and to acquiring a practise, and it usually is several years before they receive hospital appointments, as a result of which they become available as teachers.

In consequence of the lack of proper, uninterrupted, early training under capable supervision, and as a result of the temporary want of extensive opportunity for bedside study and large experience at the most important period of his life, it is almost impossible for a clinical man to reach any commanding position as a teacher in his line of work until he is past middle life. This is not true in other lines of work.

There is no denying the fact that the Harvard Medical School has done little for its clinical men except to give them titles which might prove of value in private practise. It has paid them very small salaries and given them absolutely no assistance in their clinical teaching. The school has received from many of its devoted clinical men, some of whom have made great sacrifices for its sake and have brought it great honor and reputation, much more than it has given them.

Under present conditions, with the school giving its clinical instruction in hospitals which are under the control of others, with underpaid clinical teachers who have limited terms of hospital service, and who are unable to select from the hospital staff and from the internes, as their assistants, the men they consider best fitted to teach and to advance the knowledge of clinical medicine, the school has about reached its limit of development.

From now on the Harvard Medical School must have a new ideal to strive for, namely, well-paid clinical instructors whose chief interests shall be teaching and scientific medical investigation. In other words, the clinical departments must be put on a true university basis like the laboratory departments and entirely freed from the outside influences which hitherto have controlled them. To render this ideal possible two things are absolutely necessary:

1. A sufficient endowment to enable the school to pay clinical teachers adequate salaries so that they can afford to devote all their time to teaching and to research work.

2. A hospital of its own, or one in which it has the power of appointment, in order that it can do the following things: (*a*) Furnish continuous services to its clinical teachers. (*b*) Establish salaried teaching positions in the wards for young clinical men who will have charge (under the supervision of visiting men) of the medical students, who will carry on scientific investigation of clinical cases based on the broadest training in laboratory methods, and who will study to fit themselves to be the clinical teachers of the future. (*c*) Enable the clinical departments to call the exceptional clinical man from any part of the world and put him in control of ward patients. (*d*) Place students, after they have received sufficient preliminary training, in the wards as a part of the hospital machinery so that they all may acquire practical experience under proper supervision before they undertake to practise medicine on their own responsibility.

To demand such possibilities is perfectly reasonable. Germany owes her great clinical teachers to such a system of being able to call to any vacant clinical position the best available man in the country. Consequently men fit themselves by years of study in the hospitals to fill these clinical positions. At least two medical schools in this country have adopted the same system.

If the Harvard Medical School does not adopt some such policy it will not be able to hold a leading position in this country like the other departments of the university, but will remain a local institution, and we shall continue to hear, as often in the past, the fatal excuse of expediency instead of commanding ability urged in behalf of a clinical man's appointment.

F. B. Mallory.

Harvard Medical School.

SCIENTIFIC BOOKS.

A Text-book of Sanitary and Applied Chemistry: or The Chemistry of Water, Air and Food. By E. H. S. Bailey, professor of chemistry, University of Kansas. New York, The Macmillan Company. Pp. xx + 345. $1.40.

The purpose of this text-book on applied chemistry is best stated in the author's own words:

> A knowledge of the relations of health to pure air, unpolluted water, and wholesome food will have much to do with improvement of sanitary conditions, not only of students themselves, but, through them, of the people at large. The air is usually said to be free, but pure air and sunshine cost money, as the crowded tenements show. The best lighted and ventilated rooms are worth the most. * * *
>
> It is certainly time that the people should have some practical knowledge of food and medicine. Without this knowledge they will continually be imposed upon by those who have something to sell which may be worthless as a food, or dangerous as a medicine. * * *
>
> Schools and colleges are beginning to see their opportunity to impart a kind of knowledge that is practical and sane. * * *
>
> A thorough understanding of the facts of applied chemistry will not make the skilled workman, nor will the theories of chemistry make the accomplished cook, but a broad and thorough knowledge of the underlying principles will go very far toward developing common sense in hygiene and in the selection and preparation of food.

In fulfilling his purpose, the author in Part I. (one third of the book) discusses air and fuels in their relation to heating and ventilation, lighting by the various agents now in use, water supply and purification, disposal of household waste; he devotes a chapter to cleaning, soaps and bluing, and another to disinfectants.

In view of the fact that physicians are agreed that fresh air is the first requisite to maintaining or regaining health, it is fitting that the longest chapter in this part of the book should be given to the atmosphere. A partial analysis will serve to indicate the exhaustiveness with which the subject is treated: History of Atmospheric Theories, Composition of the Air, Methods for Analysis of Air, Carbon Dioxide in Free Air and in Closed Rooms, Effect of Impure Air on the System, Nitric Acid and Other Impurities, Ozone and its Properties, Effect of Carbon Monoxide on the system, Methods of Studying the Dust of the Atmosphere, Bacteria in City Air, Arsenic in the Air, Injurious Trades, Composition of Ground Air, Effects of Ground Air on the System, Offensive Gases.

Part II. deals with food, food materials, food accessories, preservatives, beverages and dietaries.

The method of treatment is substantially as follows: history, statistics of production and consumption, classification of various forms of a given food material, chemical composition, physical properties, methods of preparation in edible form, food value.

The lists of adulterants to be looked for and the tests to discover them constitute a timely feature.

The book contains valuable tables of composition, numerous well-chosen experiments for the student, and an extremely good, though not exhaustive, bibliography.

The style of the book and the directions for experiments, while terse, are always clear.

The plan is admirably adapted to the use of students in the higher schools, academies, agricultural colleges and technical schools. The progressive college may for once waive its fear of applied science, and welcome a book so suggestive of lines of research. It is much to be desired that every college will at least have the book in its reference case.

The student of sociology, the settlement worker and every seeker after truth must, in order to know his subject, get an acquaintance with its ancillary factors. He must have his science on a positive basis. A scientific knowledge is as necessary in questions of education, reformation and the improvement of social physical conditions as it is in the treatment of a diseased individual. In this book of Professor Bailey's the student will find much that is helpful to his understanding of the causes of the conditions of daily living. Unless he has such knowledge, he is in no position to make suggestions for betterment.

The following paragraph serves to show the value of the book in this direction:

> It is estimated that at least 10 per cent. of the income is squandered not only by the well-to-do, but frequently also by those who have a very small income and so can ill afford it, in expensive food material which affords little nutrition, in unsatisfactory methods of preparation, in selecting foods out of season, by throwing away much valuable food material, and by using badly constructed cooking appliances. Much careful investigation is needed along these lines, and painstaking instruction will ultimately improve these conditions which are at present so much deplored.

ELLEN H. RICHARDS.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

ANIMAL MECHANICS.[1]

THE author's previous contributions to animal mechanics, to some extent in company with the late Professor W. Braune, are well known to anatomists; though it is to be feared that they are held in more respect than in intelligent appreciation. The anatomist who is not a trained mathematician can very well understand that most if not all of the models and diagrams used to illustrate the simpler problems show at most the central principle, if we may so express it, and show it in a painfully diagrammatic way. It is much as if an artist were to give us a man's face drawn in straight lines. We may say, and truly, that the essential idea is given, but that much is left out; and we are not very clear as to the precise importance of the omissions. As the mathematician adopts a more thorough system we feel an increasing difficulty in following it. We can see that the method is an improvement; we can appreciate even without full understanding (if this be not a paradox) that the work is honestly done; but a clear idea does not come to us. One of the causes of the want of sympathy between mathematicians, in so far as they are mathematicians, and the rest of the world is that the former with all their learning can not do justice to the full stupidity of the non-mathematician when the question is one of mathematics. It is impossible for him to grasp how sincere the outsider is in his ignorance, or rather in his incapacity.

This book is devoted to an analysis of the movements of joints in their mutual relations. It is clear that the simplest system is one of two rigid bars playing one on the other. If we restrict the motions to one plane a child can understand it; but if we go beyond that the ordinary man is at once out of his depth. Add one more bar still keeping to one plane, and the difficulty increases. Make the number of the bars and the planes indefinite and where are we? The mathematician would tell us to go one step at a time; but somehow we lose our heads as we should did we receive the same instruction relative to walking on the tight rope.

The author writes as follows in his preface:

> As the whole animal organism has for its first object the movement of the living body through joints, I have devoted this book in the first place to physicians, especially to physiologists and anatomists as well as to zoologists. I have therefore attempted to make the mathematical deductions so elementary and to present them in so clear a manner that they will be easily intelligible even to those who are not mathematicians.

[1] 'Theoretische Grundlagen für eine Mechanik der lebenden Körper, mit speziale Anwendungen auf den Menschen sowie auf einige Bewegungsvorgänge an Maschinen in möglichst elementar Weise dargestellt.' Von Otto Fischer. Mit 67 in den Text gedruckten Figuren und 4 Tafeln. Leipzig und Berlin, Druck und Vorlag von B. G. Teubner, 1906.

Frankly it seems to us that the work is beyond these outsiders, but we are sure that those who are competent will find it a work of much value. T. D.

Kurzes Lehrbuch der organischen Chemie. Von Professor Dr. A. Bernthsen. Neunte Auflage, bearbeitet in gemeinschaft mit Dr. Ernst Mohr. Braunschweig, Fr. Vieweg und Sohn. 1906. Pp. xxii + 638.

The approval with which this book has been received is indicated by the fact that it has reached its ninth edition and has been translated into English, Russian and French. This success is well deserved. Within a comparatively small compass it gives a remarkably comprehensive oversight of the fundamental principles and of the important compounds of organic chemistry. The most important change in this edition is the addition of a third division called 'Heterocyclic Compounds,' though a considerable portion of the material in this division was formerly given under the division called 'Benzene Derivatives,' but in this edition named 'Isocyclic Compounds.' The aliphatic compounds are still called 'Methane Derivatives,' as in former editions.

On p. 70 Schorlemmer's classification of paraffins as normal, iso-, meso-, and neo-paraffins is still given, although the last two classes are never mentioned in current literature and have been practically forgotten by most organic chemists. It is a pity we have no means of eliminating unnecessary and little used terms of this sort.

The most characteristic and valuable features of the book are the clear, concise statements given at the introduction of each new class of compounds, presenting the most important methods of preparation for the class and the facts on which our knowledge of the structure of the characteristic group of the class is based. The fault of the book, if it has one, lies in the brief description of an excessive number of compounds, far beyond the possibility of memory for any one. The effect must be bewildering and discouraging to the beginner. W. A. Noyes.

DISCUSSION AND CORRESPONDENCE.

AN UNUSUAL METEOR.

To the Editor of Science: On page 151 of your issue for August 3, Mr. E. E. Davis, of Norwich, N. Y., describes a very interesting meteor train observed by him about 5:30 or 6 P.M., when traveling between Cortland and Elmira, N. Y. The changes in his own location during the fifteen minutes must have had an appreciable influence on the appearance of this trail, but will scarcely alter our general conclusion that it was a typical case illustrating and settling a matter that has caused a little speculation among students of the subject. If a meteor leaves a visible train behind it we are apt to think that this is a series of luminous particles, lying in a straight or gently curved line, and that they will, by reason of unequal gravity, resistance of the air and possibly winds in the upper atmosphere, drift along unequally, so that the straight trail may gradually become irregular. This may be true in some cases, but it is incredible that any plausible movement in the thin upper air should affect the course of the scattered luminous particles. They must be considered as moving, with rapidly diminishing velocity, under the influence of three forces—namely, their initial momentum, the attraction of gravitation and a very gentle resistance from the atmosphere. In most cases the initial momentum is mainly that due to the straight-line motion of the original meteor; but in some cases this meteor may be revolving on its axis in a manner quite analogous to the less rapid rotation of a comet's nucleus, and just as the comet of 1875 sent out a series of tails from its revolving nucleus, so with the streams of material issuing from these rapidly revolving meteors. The diagrams submitted by Mr. Davis would indicate that five rotations were made in that portion of its track represented by his third curve; the motions of the particles outward from the meteor's track were so slow that it made a barely appreciable sine curve, or a broadening of the track, in his first and second curves, but a very large jagged sine curve in his sixth, or last, curve. This latter broadening re-

quired ten minutes of time, and if we had exact measurements of angles and times we should undoubtedly from these curves be able to deduce the rate of rotation of the meteor, and possibly its mass.

Most of the aerolites that come to the earth show, by their pitted surfaces, that the meteoric material is being split off or ejected quite uniformly from the whole surface; but some meteors, like some comets, may have only a very few regions on the surface from which material is ejected with any special force. In Mr. Davis's meteor of October 13 we seem to have a case in which some one spot on the side of the meteor, namely somewhere between its head and its tail, ejected its material freely and with considerable force, in a direction at right angles to the axis of rotation, or the line joining head and tail: it represents the rare case of a symmetrical revolving meteor.

CLEVELAND ABBE.

WASHINGTON, D. C.,
August 15, 1906.

SOME 'DEFINITIONS' OF THE DYNE.

IT would seem comparatively easy for any one whose mind has dwelt comprehendingly upon the relation $F = ma$ to define correctly the unit of force in terms of mass and acceleration. But such is evidently not the case. Of the text-books of physics immediately at hand, four give incorrect definitions of the dyne. In each case the author is a man of high and wide reputation as a writer and teacher. In quoting the definitions in question, I have taken the liberty of italicizing the words to be omitted with advantage.

(*a*) Force: dyne. 1 g. given unit acceleration *in 1 sec.*

(*b*) The practical unit of force is the dyne. * * * It produces unit acceleration of unit mass *in unit time.*

(*c*) The absolute unit of force (in the C. G. S. system) is called a dyne, and is that force which *in one second* is capable of giving to a gram-mass an acceleration of one centimeter per second.

(*d*) The absolute unit of force is the force that, acting *for unit of time* upon unit of mass, will produce unit of acceleration. * * * The centimeter-gram-second (C. G. S.) unit of force is the force that, acting *for one second* upon a mass of one gram, produces an acceleration of one centimeter per second. It is called a dyne.

The first two books are intended for universities and colleges, the latter two for preparatory schools, and all four, I believe, have been widely used.

It is perhaps proper to state that each of these authors gives a correct definition in terms of mass, time and change of velocity, but each seems implicitly to ignore the fact that acceleration is not change of velocity, but is *rate* of change of velocity. To conclude, the dyne is the force that, acting on a mass of one gram, gives to it C. G. S. unit acceleration (for which there is no name), irrespective of the time during which the force acts upon the mass, whether it be the millionth part of one second, or one million eons. $F = ma$, and when $m = 1$, and $a = 1$, then $F = 1$.

Similar errors are of course committed in defining the poundal. The text from which the quotation (*d*) above is taken gives:

> The foot-pound-second (F. P. S.) unit of force is the force that, applied to one pound of matter *for one second*, will produce an acceleration of one foot per second. It is called a poundal.

And a fifth book, also for preparatory schools, states:

> In the F. P. S. system the unit is the poundal, which is the force that on being applied to 1 lb. of matter *for 1 sec.* will give to it an acceleration of 1 ft.

In this last case, the same mistake is made in the general definition of the absolute unit of force, but the dyne, specifically, escapes with a defective definition in terms of mass, time and change of velocity.

HAROLD C. BARKER.

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PENNSYLVANIA.

SPECIAL ARTICLES.

A PECULIAR MUTATION OF THE PINE MARTEN.

A TRAPPER'S skin, without skull, of a pine marten (*Mustela americana actuosa* Osgood) recently offered for sale to the National Museum by Mr. James Aitchison, Nulato, Alaska,

differs strikingly from any marten skin in the museum collection, or elsewhere, so far as I am aware. The long bristly hairs are everywhere lacking on the skin, which bears about the same relation to a normal marten that a plucked beaver or seal skin does to an unplucked one. Coues[1] describes the pelage of the marten as consisting of three kinds of hairs:

> The first is very short, soft and wool-like * * * the second soft and kinky, like the first but very much longer, coming to the general surface of the pelt. The third is the fewer, still longer, glossy hairs, bristly to the roots.

The specimen in question entirely lacks the long glossy hairs, and possesses a very few only, of Coues's second variety of hairs, with soft kinky base and short bristly tip. The entire pelage is practically composed of the soft short underfur. The general color of the skin is not abnormal; the head, chest, legs and feet are perhaps a little darker brown than the usual run of skins. The general size and proportion of the skin differ in no way from that of a normal marten.

Marcus W. Lyon, Jr.

AN OBJECT-FINDER FOR THE MICRO-PROJECTION APPARATUS.

No doubt every one who has undertaken to project the image of a microscopic preparation directly upon a screen for class or lecture demonstration purposes has realized the difficulties in the way of rapid and accurate location of the exact part of the object desired. Indeed, this method of illustration is at present seldom made use of, owing chiefly to the great loss of time involved, and to the distracting effects upon the attention of the class or audience.

Some time ago the writer devised an attachment for the micro-projection apparatus which so effectually overcame the difficulties mentioned above as to render this method of demonstration quite as expeditious and precise as that with ordinary photo-micrographic or other lantern slides. With this condition assured, the advantages of the method are obvious. Inquiries regarding this apparatus have led to the belief that the publication of a description of it may be worth while. The following description and the accompanying figures represent the latest improved form of the attachment.

As indicated in the figures, this attachment consists of a rotary object stage and a secondary, short-range projector, mounted on the same base-board with the usual projection apparatus. The light is taken from the electric arc, or other illuminant, *L*, of the main projector, through the opening at the side of the hood. In place of the blue or purple glass commonly found in this opening, there is put a simple collimating lens. The parallel emergent rays are reflected by the mirror, *A*, into the line of the optical axis of the finder, which is parallel to that of the projector proper. By means of the condenser, *B*, these rays are brought to a focus at the position of the object on the revolving stage *C*. A good hand lens at *D* projects an image of the object upon the small screen, *E*, which need not be more than about thirty inches from the object. The plan of the base-board, Fig. 2, will make clear the arrangement of the parts.

Fig. 3 shows the plan of the rotary stage-plate, with four openings and spring clips for holding the slides in position. Fig. 4 represents a face-view of the screen, *E*, which has a dead-white surface, with the two centering lines in black. All the parts are mounted on telescoping pillars, and are made adjustable in position on the base-board.

The rotary stage-plate requires special care in its construction and mounting, as it must be both accurate and rigid. Fig. 5 shows the details of the mounting. On top of the heavy pillar is the sleeve, made from thick-walled brass tubing. On the ends of the sleeve are the two collars, *b* and *c*. Working in the sleeve is the shaft, which is held in position by the collar *a* and the nut *n*. The plunger, *p*, actuated by the spring, *s*, passes through the collars, *b* and *c*, and engages the collar *a*. Four holes are drilled in the collar *a* for the plunger, and these holes must be exactly

[1] 'Fur-bearing Animals,' U. S. Geol. Survey, Miscell. Pub., No. VIII., 1877, p. 82.

ninety degrees apart. The stage-plate, *f*, is screwed firmly to the shaft and collar *a*, with the stage-openings precisely in the same radii with the four holes in the collar *a*.

ject which is now centered in the finder will be centered when rotated into the axis of the projector. Hence, while the first object is being projected on the large screen, the operator may be finding the part of the third object which he wishes to show, the second having been located already. When the second is to be thrown upon the screen, the plunger is disengaged by means of the thumb-block *t*, and the stage is rotated 90°, when the plunger automatically locks the mechanism in the proper position. Slides of uniform thick-

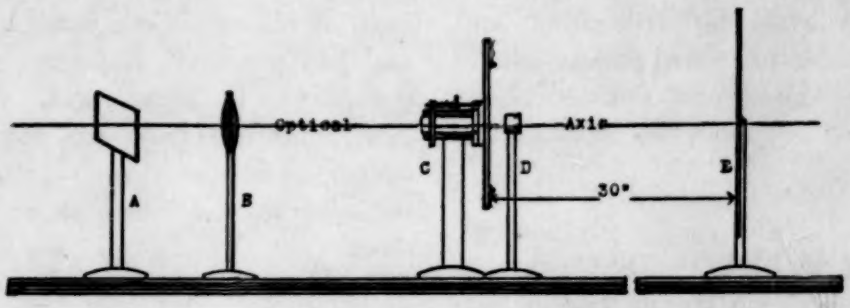

FIG. 1. Side Elevation

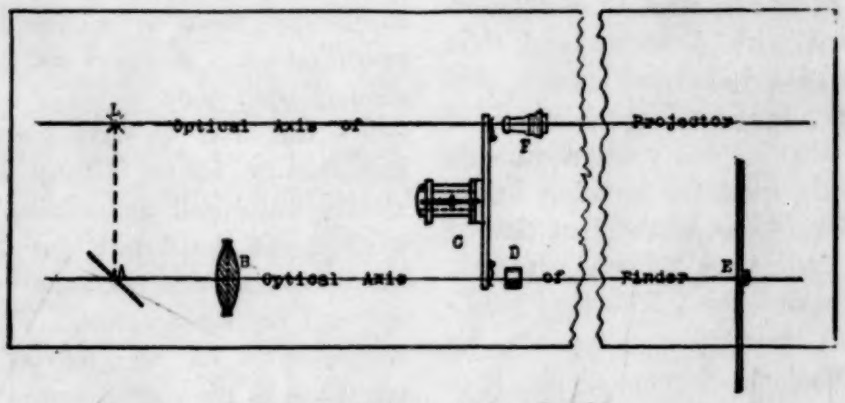

FIG. 2. Plan of base level.

FIG. 3.

FIG. 4.

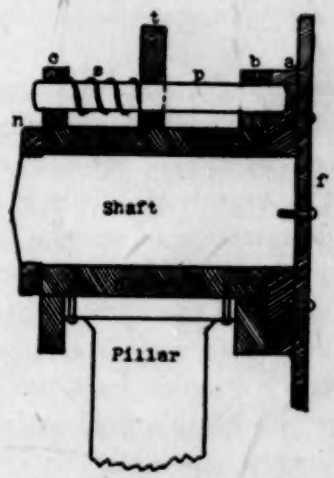

FIG. 5.

To operate the finder, it is first made par central, as follows: A slide bearing fine cross-lines, such as a stage micrometer, is accurately centered under the objective, *F*, of the projector. Then the stage is rotated 180°, and, without moving the slide, the image is brought to center on the screen *E* by adjusting the lens *D* and the screen *E*. Evidently, any ob-

ness are used in mounting objects for projection purposes, so that the projector may be brought to the proper focus with the least possible delay.

To secure the best results it is evident that the rotary stage must be accurately and rigidly built, in order to secure precise double centering of the object, and freedom from vibration.

AMON B. PLOWMAN.

PITTSBURG, KANS.

HELIUM IN NATURAL GAS.

SOME three years ago a strong flow of natural gas was struck at Dexter, Kans. Upon the first attempt to utilize this, it was found that it would burn with difficulty and that only in previously heated enclosed space. Experience has so far improved the method of handling the gas that at the present time it is being successfully used for burning brick. The whole difficulty is due to the fact that it contains only a little over fifteen per cent. of combustible constituents. The first publication upon this gas was a paper by Haworth and McFarland, SCIENCE, Vol. 21, p. 191, in which they reported that it contained in addition to a large amount of nitrogen some inert residue.

We have taken up the further investigation of this gas and at the New Orleans meeting of the association Dr. E. H. S. Bailey reported for us that it contained 1.84 per cent. of helium. The occurrence of such a large percentage of helium in one of the gases of the Kansas field has led us to the examination of others. Up to the present time we have investigated some twenty samples from the most widely separated points of this field and have found helium in every case, but always in much smaller amounts than at Dexter. From the latter gas, we have with the aid of liquid air extracted a very fair amount of helium.

Accompanying the determination of helium, we are making complete analyses of the gases and shall have within a short time results from thirty to forty samples covering in detail the entire Kansas field as at present developed—an area of some twelve thousand square miles. The rather large number of analyses is required because the gas is extremely varied in its character. This is illustrated by the fact that the wells at Arkansas City, less than twenty miles from Dexter, yield more than 97 per cent. of combustible gases and only .16 per cent. of helium as compared with 15 per cent. and 1.84 per cent., respectively, for these constituents in the Dexter gas. Samples are also being obtained from the other fields of the country and the results from these will be included in a detailed paper to be published soon.

As the gases are run through the analyses spectral tubes are filled, and various residues and fractions are saved with the intention of subjecting them to a detailed spectroscopic examination. Some work of this kind has already been done.

We feel that we have here a very unusual opportunity for obtaining helium in practically unlimited quantities, and as we have worked out the details for its separation we shall have a large amount prepared and will attempt its liquefaction. While the necessary preparations are in progress we shall devote ourselves to the spectroscopic work above mentioned.

HAMILTON P. CADY,
DAVID F. MCFARLAND.
THE UNIVERSITY OF KANSAS, LAWRENCE,
July 12, 1906.

CURRENT NOTES ON METEOROLOGY.

DR. HANN AND THE 'METEOROLOGISCHE ZEITSCHRIFT.'

THE fortieth anniversary of Dr. Hann's assumption of the editorship of the *Meteorologische Zeitschrift* was fittingly observed by the publication of a special number of that excellent journal, to which friends and colleagues contributed articles. The 'Hann-Band' numbers 404 pages; contains 42 papers by as many different writers, and has as a frontispiece an engraved portrait of Dr. Hann. An appropriate introduction, by Pernter and Hellmann, refers to the remarkable work which Hann has done for his science in the *Zeitschrift*. Among the papers, all of which are of immediate importance, the following are of most general interest: Paul Schreiber:

'Untersuchung über die Genauigkeit der Tages-, Monats- und Jahresmittel aus den Temperaturbeobachtungen für die drei Stunden-Kombinationen: 6 A.M.–2 P.M.–10 P.M.; 8 A.M–2 P.M.–8 P.M.; 7 A.M.–2 P.M.–9 P.M.' Dr. Schreiber is at the head of the Meteorological Institute of Saxony, and is well known through his accurate statistical work there. H. H. Hildebrandsson: 'Sur la Circulation des Couches supérieures de l'Air au dessus du Maximum de l'Atlantique Nord.' Dr. Hildebrandsson, as is known to readers of these notes, has lately advanced a new view of the general circulation of the atmosphere, and all his contributions to this subject are of peculiar interest. A. Woeikof: 'Die Verteilung und Akkumulation der Wärme in den Festländern und Gewässern der Erde.' Woeikof has given special attention to the larger relations of land and water and climate; this is a study in this connection. W. N. Shaw: 'The Law of Sequence in the Yield of Wheat for Eastern England, 1885–1904.' In this paper the director of the British Meteorological Office gives the results of his recent studies into the relations of weather and the wheat crop in England. L. Teisserenc de Bort: 'Sur la Circulation générale de l'Atmosphère,' an investigation of the relations between temperature and pressure at sea-level and in the free air. Cleveland Abbe: 'The Trade Winds and the Doldrums,' being notes on observations made by Professor Abbe during a voyage in the U. S. S. *Pensacola* in October, 1889, and May, 1890. A. L. Rotch and L. Teisserenc de Bort: 'The Meteorological Conditions above the Tropical North Atlantic,' dealing with results already summarized in these notes.

ANTI-TRADES IN CENTRAL AMERICA AND THE WEST INDIES.

A BELATED note on the drift of the upper air currents as shown by the carriage of smoke and ashes during the volcanic eruptions of 1902–3 in the West Indies and Central America is found in the *Meteorologische Zeitschrift* for July. The writer, Dr. K. Sapper, points out that but little attention has yet been paid to this subject. The anti-trade in the West Indies was clearly evidenced by the drift of smoke and ashes from St. Vincent and from Mont Pelée. The altitude of this upper current is not great, but was not accurately determined. In Central America the anti-trade seems to occur, if at all, at very great altitudes. Observations of the drift of smoke and ashes at heights of 7,000 to 8,000 meters above sea-level showed a movement towards the west or north-northwest. There was a slight carriage of ashes in an easterly direction, but of no considerable importance. The famous eruption of Coseguina, in 1835, showed that in southern Central America, at any rate, the anti-trade blows from west-southwest. Ashes fell in Jamaica. Smaller eruptions of other volcanoes in 1880, 1864, 1828 and 1833 showed a westward drift of the upper currents.

RAINFALL, TEMPERATURE AND TREE GROWTH.

IN the *Bulletin of the American Geographical Society* for July, Mr. Henry Gannett discusses 'Certain Relations of Rainfall and Temperature to Tree Growth' in the western United States. He finds that the timber-line has a mean annual temperature of approximately 30°, but the data relating to rainfall are more definite and more significant than those of temperature. It appears that the lower limit of the yellow pine is at or just below 20 inches of rainfall. The lower limit of the red fir is at or about 30 inches, and there is apparently no upper limit, the fir being abundant where the rainfall exceeds 100 inches a year. The redwood belt in California includes only one station with a rainfall less than 30 inches. This seems to show that the isohyetal line of 30 inches is the lower limit of this species.

CUMULUS CLOUDS OVER THE SAN FRANCISCO FIRE.

WE have seen but one notice of the development of cumulus clouds over the fire which followed the San Francisco earthquake. This is in a letter from Mr. Charles Van Norden (*Nature*, Vol. 74, 1906, p. 133), who observed the conflagration from the deck of a ferry boat. A white cumulus cloud was seen, dark

at the bottom, hanging over the city. The morning was clear and mild, and no other cloud was in sight. Cumulus clouds over fires have frequently been observed, and they have several times received mention in these columns (see SCIENCE, V., N. S., 1897, 60–61, for a good illustration of a cumulus cloud thus formed).

R. DEC. WARD.

HARVARD UNIVERSITY.

PROPOSED UNION OF MEDICAL SOCIETIES IN LONDON.[1]

A MEETING of the General Committee of Representatives of Medical Societies in London was held on July 17 to consider the report of the organizing committee.

Sir William Church, who was in the chair, pointed out that at the first meeting of the members of societies, which was held at the Royal College of Physicians in 1905, the feasibility of union was considered, and that as the outcome of the opinions expressed at that meeting a committee of representatives of the various societies was appointed. The committee of representatives appointed an executive committee to go more thoroughly into the feasibility of union and to outline some scheme of union if such were thought possible. This executive committee reported that a union was feasible on certain lines, and its report was confirmed by the committee of representatives on July 19, 1905. With that report the executive committee's work came to an end, and an organizing committee was appointed to draw up a definite and, as far as possible, a detailed scheme of union. This scheme was before the meeting, and if approved would be sent to the societies to act upon or not as they thought fit. Those societies which approved of the report and decided to join the proposed union would be asked to appoint a representative before December 7 next to sit upon a committee which would act as the first council of the new society and deal with the necessary details of amalgamation.

The report recommended that all male members of those societies which took part in the amalgamation should be permitted to join the new society on its formation as members or fellows without election, and that all women members of a society taking part in the amalgamation should become members of the corresponding section or sections of the new society. It was further recommended that the society should consist of the following sections which represented existing societies, but that the new society should have power to add new sections:

1. Anæsthetic.
2. Balneological and Climatological.
3. Clinical.
4. Dermatological.
5. Diseases of Children.
6. Electro-Therapeutical.
7. Epidemiological.
8. Laryngological.
9. Life Insurance.
10. Medical.
11. Neurological.
12. Obstetrical and Gynæcological.
13. Odontological.
14. Ophthalmological.
15. Otological.
16. Pathological.
17. Surgical.
18. Therapeutical.

It was hoped that in the early future an anatomical and physiological section and a section of preventive medicine might be formed. The Medico-Psychological Association and Medico-Legal Society hoped to join the new society at some future date. It was recommended that each section should be self-governing as far as possible, and should have direct representatives on the council of the society and on the editorial committee, but that its expenditure should be subject to the control of the finance committee of the general council. The general management of the society would be under the control of a general council consisting of the president, the presidents of the various sections, two treasurers, two librarians, two secretaries and eight other fellows.

[1] From *The British Medical Journal.*

CHEAPER LIQUID AIR.

ACCORDING to a consular report recent experiments in England of an invention by Mr. Knudsen, a Dane, furnished liquid air at

one sixth of the present market price, and give promise of an ultimate low price of a fraction over two cents per gallon. The result is secured by purely mechanical means, without an atom of added chemicals. Atmospheric air is first purified and then compressed by stages to 2,500 pounds to the square inch. It is finally reduced to 125 pounds to the square inch, which then cools and liquefies the high-pressure air. The oxygen gas produced by separating the nitrogen from the liquid air is claimed to be purer than that of the old method, and can be supplied in the liquid as well as in the gaseous form. One gallon of liquid air equals approximately 128 cubic feet of oxygen gas, which retails at six cents per cubic foot. The new price is one cent. Liquid air has been successfully used in coal as an explosive, being quite safe where fire damp and other explosive gases exist. Liquid oxygen is also used for welding steel pipes, boiler shells and plates for shipbuilding instead of riveting. That oxygen and nitrogen can be separated from liquid air and sold retail at $1.20 per gallon shows great commercial possibilities. The use of nitrogen for agricultural purposes opens yet another field. The maturing of liquors will be helped by liquid air, as also the preservation and purification of milk. As a motive power its use is considered to be quite practicable for small powers. The British government is already carrying out a number of experiments with a view to the utilization of liquid air for various purposes.

RADIUM.[1]

I venture to think that the thanks of the public are due to Lord Kelvin for his timely and outspoken protest against the conclusion being drawn, from the evidence at present before us, that it is proved that there is a 'gradual evolution of one element into others.' No one has yet handled 'radium' in such quantity or in such manner that we can say what it is precisely. That helium can be obtained from 'radium' appears to be proved; but no proof has yet been given that it is not merely contained in it. As I remarked at York last week, physicists are strangely innocent workers; formulæ and fashion appear to exercise an all-potent influence over them. There was a time when the expression 'scientific caution' meant the highest degree of caution, and it was supposed to be the attribute of workers in science. Workers in the radium school appear to have cast caution to the winds and to have substituted pure imagination for it. Among ourselves, we should always be at liberty to postulate the most crack-brained of hypotheses, to dream the wildest of dreams, as a means of guiding inquiry; but we should not court popularity on such a basis. By so doing we lose all claim to guide public opinion.

HENRY ARMSTRONG.

I am glad to have contributed towards eliciting Lord Kelvin's views on this subject. Those interested will no doubt judge for themselves whether or not the precautions adopted by Ramsay and Soddy, Himstedt and Meyer, and Curie were such as to make it certain that helium is continuously evolved from radium, as those writers supposed.

As to the internal heat of the earth, Lord Kelvin quotes the generally accepted conclusion that the life of radium is limited to a few thousand years. From this he argues that the radium now in existence has not been there long enough to heat the earth to its present high internal temperature. To this I reply that it is true that the actual radium now in existence has not done the work throughout, but that the supply of radium in the earth is maintained at a constant level by the production of fresh radium by uranium, contained in a small proportion in the rocks. Lord Kelvin, anticipating this reply, expresses his dissent from the view, current among workers on radioactivity, that radium is continuously produced by uranium. I should like to ask a simple question. Lord Kelvin disbelieves that radium is being generated from any parent substance. How does he explain the existence of radium in the earth at present? On his own showing the identical radium now existing has not been there long. Is he prepared to assume that it was miraculously created in comparatively recent times?

R. J. STRUTT.

In your yesterday's issue I see letters of Sir Oliver Lodge and Mr. R. J. Strutt, replying to

[1] Correspondence in the London *Times*, called forth by a letter from Lord Kelvin, reprinted in the issue of SCIENCE for August 24, p. 255.

my letter to you of August 9 regarding radium.

After a kind personal reference to myself, Sir Oliver Lodge says, "but it is also known that" Lord Kelvin's mind "has not always submitted patiently to the task of assimilating the work of others by the process of reading, and our hope has been that before long he would find time and inclination to look into the evidence more fully." I am quite sure my old friend Lodge could not wilfully be unjust to me, but I do not think he knows how carefully and appreciatively I have done all I could by reading, and by personal intercourse with many of the chief workers in the field, to learn experimental results and theoretical deductions regarding radioactivity, ever since its discovery ten years ago by Henri Becquerel. I scarcely think any other person has spent more hours in reading the first and second editions of Rutherford's 'Radioactivity' than I have.

Both Lodge and Strutt refer to the slowness of the extraction of helium from radium, in the process hitherto followed; and there seems to be good reason to believe that this slowness is essential. Strutt says, "If all helium has been removed from a sample of radium, it is found that, after an interval, a further supply can be extracted." The last clause shows that the initial 'if' was wrong; and that some helium remained in the modified sample of radium. This view is thoroughly in accordance with Rutherford's second edition (1905), p. 284, in which it is suggested that 'uranium, thorium and radium are in reality compounds of helium'; and, more particularly, that radium (atomic weight 225) may be a compound of four atoms of helium (atomic weight 4×5) and one atom of lead (atomic weight 205).

As to the suggestion, made first, I believe, by Sir George Darwin about three years ago, and favorably received by Rutherford, Strutt and others, that our present underground heat, and sun-light and sun-heat are due to radium, I must, for the present, limit myself to two sentences: (1) Radium alone is quite insufficient, its duration as a source of energy being estimated by Rutherford (2d edition, p. 458) as not more than a few thousand years ('the average life of radium is 1,800 years'). (2) The suggestion that in uranium, thorium, actinium and other matter capable of being 'transformed slowly into radium,' we have at least a million times as great a store of energy as we may think we have in radium, practically available for sun-heat and underground heat, is not validly supported by any experimental evidence hitherto published.

KELVIN.

Your leading article (August 18) and recent correspondence show that an emphatic statement is needed to make clear to your lay readers:

(1) That radium is not an ordinary chemical compound.

(2) That it does disintegrate with explosive violence.

(3) That it is present in sufficient quantity to account for the heat of the earth.

(4) That its disintegration is not altered by any known physical conditions.

Some experimental results obtained by me last spring at Montreal, under the guidance of Professor Rutherford, are in good agreement with those found independently and by a different method by the Hon. R. J. Strutt. The equivalent amount of radium present in the upper layers of the earth was determined by the penetrating radiation resulting from the active matter. An account of this work has been communicated to the *Philosophical Magazine* and is in the printer's hands.

It is certain that radium does occur in sufficient quantity, and that its heat energy is of sufficient magnitude, to account for the existing temperature-gradients of the earth. Until we can conduct experiments in the interior of the earth, the radium theory is entitled to at least as much weight as the gravitation theory.

The recent discussion in your columns has resulted in a goodly crop of errors, written by those who have contented themselves with reading rather than with research work. I believe that no actual worker at the subject dissents from the general conclusions contained in Rutherford's 'Radioactivity.'

For example, it has been implied that radium is merely an ordinary compound of lead (?) and helium. But no ordinary chemical compound projects a particle, having the mass of a helium atom, with a velocity almost of the order of the velocity of light.

It has been stated that the disintegration of radium occurs too slowly to be detected by direct observation, and that is true. But some of the other active bodies, such as the subsequent products of radium, disintegrate with no less violence in a few minutes. It has been suggested that the disintegration may be retarded by pressure or by lack of concentration; but all the evidence—and there is much—indicates that the process of disintegration can neither be accelerated nor retarded by temperature, pressure, concentration, or other physical changes.

It is to be hoped that reverence for a great name and an honored veteran will not induce your readers to regard lightly the brilliant and remarkable series of recent scientific discoveries in radioactivity.

A. S. EVE.

SCIENTIFIC NOTES AND NEWS.

DR. JOSÉ DE AGUILAR, director of the Mexican Geological Survey, has been elected president of the International Geological Congress, which met last week in Mexico City.

SIR DAVID GILL, astronomer royal at the Cape of Good Hope and president-elect of the British Association for the Advancement of Science, has been elected a foreign member of the Accademia dei Lincei, Rome.

DR. OTTO BÜTSCHLI, professor of zoology at Heidelberg, has been elected a foreign member of the Brussels Academy of Sciences.

IN connection with the celebration of the quater-centenary of the foundation of the University of Aberdeen, the University of St. Petersburg has conferred its honorary membership on the lord rector, Sir Frederick Treves, the eminent surgeon and anatomist.

DR. EDOUARD ZELLER, the eminent writer on the history of philosophy, celebrated on August 25 the seventieth anniversary of his doctorate.

DR. JOHANN RANKE, professor of anthropology and general natural history at Munich, has celebrated his seventieth birthday.

PROFESSOR R. B. DIXON, of Harvard University, has completed an ethnological and philological exploration of the Chimariko Indians of California in connection with the Ethnological and Archeological Survey of California. The Chimariko constitute the Indian stock which is nearest to extinction of the many in California, and Professor Dixon found only four or five survivors. He was able to obtain particularly full information as to the language.

MAJOR RYDER, R.E., who had charge of the expedition to Gartok and western Tibet after the capture of Lhasa, has returned to India, where he has been appointed superintendent of the northern circle of frontier surveys.

THE annual course of Lane medical lectures was given in Cooper Medical College, San Francisco, by Dr. John McVail, Glasgow, Scotland, on August 20 and the five following days. The general subject of the lectures was 'The Prevention of Infectious Diseases.'

DR. G. WOOBERMIN, who has recently been called from Berlin to an associate professorship at Marburg, will give a course of lectures at Yale University on 'German Culture in the Nineteenth Century.'

WE have already noted the movement in Germany to raise a memorial fund for the benefit of the widow and children of the late Dr. Schaudinn. We learn from *Nature* that an English committee consisting of Professor Clifford Allbutt, F.R.S., Sir Michael Foster, F.R.S., Mr. Jonathan Hutchinson, F.R.S., Professor Ray Lankester, F.R.S., Sir Patrick Manson, F.R.S., Professor Osler, F.R.S., Mr. John Tweedy and Professor Sims Woodhead has been formed to cooperate with the German promoters of the scheme. Subscriptions may be paid to Mr. Adam Sedgwick, F.R.S., treasurer of the fund, New Museums, Cambridge, or direct to the Schaudinn Memorial Fund at Messrs. Barclay and Company's Bank, Cambridge. American subscriptions would doubtless be welcome.

DR. H. MARSHALL WARD, F.R.S., professor of botany at Cambridge University, died on August 26, aged fifty-two years. Professor Ward, who was educated at Owen's College and Cambridge University, was for a time cryptogamic botanist to the Ceylon government; in 1883 he was elected to a fellowship at Christ's College at Cambridge, and after working as professor of botany in Forest School, Coopers Hill, from 1885 to 1895, he succeeded the late Professor C. C. Babington as professor of botany in Cambridge University. Dr. Ward was the author of works on the diseases of plants, and especially of timber trees.

DR. ALEXANDER HERZEN, professor of physiology at Lausanne and the author of numerous contributions to this science especially con-

cerned with the physiology of digestion, died on August 24, at the age of sixty-seven years.

Mr. Charles Barron Clarke, F.R.S., for many years inspector of schools in Bengal and the author of numerous contributions to botany and other natural sciences, died on August 25, at the age of seventy-four years.

We regret also to note the following deaths among foreign men of science: M. Albert Tissandière, who like his brother, the late Gaston Tissandière, was known for his researches in aeronautics; Mr. James Dredge, since 1870 one of the editors of *Engineering* and the author of works on electrical illumination, the Columbian Exposition and other subjects; Dr. Carl Thon, docent in zoology at Prague; Mr. Robert Philips Greg, who many years ago was known as a leading mineralogist, and M. Georges Salmon, leader of the French scientific mission to Morocco.

General E. P. Walker has bequeathed his library and collection of manuscripts and $30,000 to the Lloyd Library of Botany and Pharmacology, at Cincinnati.

There will be established at Bagatelle, near Paris, a 'Jardin des Fleurs,' which will include a botanic garden, a museum and laboratory.

There will shortly be held at Paris an international conference on the selection and introduction of useful plants.

The German Society of Dentists has received a bequest of 10,000 Marks from the late Dr. Adolf Witzel, professor of dentistry at Bonn, to promote the study of this subject at the German universities.

According to a press despatch from Washington, the Department of Agriculture is preparing for the increased labor and equipment involved in the enforcement of the new pure-food law, which goes into effect on January 1, next. The forces and appliances of the laboratories at Philadelphia, Chicago, Baltimore and New Orleans will be largely increased, while at New York and Boston new laboratories will be erected in which to conduct the necessary examinations of food products coming into the country. Plans for the buildings in New York and Boston have been approved by Dr. H. W. Wiley, chief of the Bureau of Chemistry. There is no money available for the construction of the buildings, but the secretary of agriculture has been assured that it will be forthcoming at the next session of congress. Assurances have been given that the money necessary to enforce the new law, through the employment of inspectors and the clerical force, will also be provided.

We learn from the London *Times* that in view of the spread of sleeping sickness in Africa and of the fact that an expedition organized by the Liverpool School of Tropical Medicine has been studying this disease for three years in the Congo, Sir Alfred Jones, president of the school, requested an audience of the King of the Belgians in order to confer with him upon the subject. In a recent letter to the secretaries of the reform committee King Leopold referred to his deep interest in this matter, and, besides offering a prize of 200,000f. for the person who should discover a remedy, he has placed a credit of 300,000f. in the Congo estimates for the purpose of prophylactic research. The committee of the school was received by King Leopold on August 23. The representatives present included the president, Sir Alfred Jones, Professor Ronald Ross, C.B., F.R.S., Professor Boyce, F.R.S., Dr. J. W. W. Stephens, Dr. J. L. Todd, Mr. R. Newstead, Dr. Evans and Mr. A. H. Milne. The king gave a most attentive hearing to the views of the experts of the school, and asked for a scheme for the prevention of the disease. He has promised his cooperation if it is in any way feasible. In conclusion, to show the value he placed upon the work of the school, he bestowed the Order of Leopold upon Professor Ross, Professor Boyce and Dr. J. L. Todd, the last-named of whom worked on trypanosomiasis in the Congo Free State for three years. The conference was followed by a luncheon at the palace.

The Journal of the American Medical Association states that the subject announced by

the medical faculty at Berlin for the essays in competition for the royal prize is: 'Comparative Research on the Histogenesis of the Heart Musculature.' The subject for the city prize essay is: 'Research on the Normal and the Pathologic Anatomy of the Appendix.'

FOREIGN journals state that the Australian government has issued a proclamation prohibiting the importation of the microbe of hæmorrhagic septicæmia, by which it was proposed to destroy the rabbit pest, except upon the condition that the packages containing the microbes be handed unopened to the state bacteriologist of New South Wales, and retained by him unused until the minister gives permission to use them. Under the Noxious Microbes Act of 1900 of New South Wales it will also be necessary for the state government to pass a regulation sanctioning experiments before anything can be done in the way of rabbit extermination. In the meantime only laboratory experiments will be carried on.

A ROYAL commission has been appointed "to inquire into the existing system of management of the lights, buoys and beacons on the coast of the United Kingdom by the three general lighthouse authorities, and as to the constitution and working of these authorities, and to report what changes, if any, are desirable in the present arrangements."

THE American Institute of Social Service will hold in New York City, in January next, an exposition of devices for safeguarding the lives and limbs of working men and women, and for preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. The interest of manufacturers generally is solicited, as well as that of organizations whose special function is to improve the conditions of labor, and a widespread response is looked for to this request for representation in the nature of photographs, descriptive drawings, models, and, as far as possible, the devices themselves in actual operation. Following are some of the groups of exhibits: Section 1. Models, photographs and drawings of scaffolding, as well as the personal equipment of workers in building trades. 2. Protective devices for boilers, water gauges, signal apparatus, boiler and pipe valves; also protective devices for electrical machinery and acetylene apparatus. 3. Protective devices for motors and power transmitters, devices for turning on power and shutting it off, belt connection, couplings, etc. 4. Fire protection and the prevention of explosives. 5. First aid to the injured. 6. Mining and quarrying; devices in use on stone-crushing machinery, etc. Storing of explosives. 7. Metal industry; safety devices for metal-working machinery. 8. Textile industry: safety devices for looms, carding, etc. 9. Leather and paper industry: safety devices for paper cutting, stamping and molding machinery. 10. Safety appliances for elevators and hoisting apparatus models. 11. Food products: safety appliances for kneading machines, rollers and cutters. 12. Personal equipment of workingmen: protective spectacles, respirators, suits, etc. 13. Workingmen's dwellings. 14 and 15. Housing: models, plans, photographs. 16. Ventilation. 17. Models, photographs and plans of toilets, dressing and living rooms, baths, etc. 18. Cooking: demonstration in heating food; models, plans, photographs. 19. Other social betterment institutions; reports of labor departments, industrial arbitration courts. 20. Agricultural machinery: safety appliances on same, demonstrated by models and views. 21. Lumber industry: safety devices for band and circular saws, planing machinery, etc., demonstrated by models. 22. Models, photographs and plans of workingmen's industrial betterment institutions of all kinds. Requests for information regarding space should be made to Dr. William H. Tolman, director, 287 Fourth Avenue, New York.

UNIVERSITY AND EDUCATIONAL NEWS.

THE new buildings of the Harvard Medical School will be formally dedicated on September 25 and 26. On Tuesday afternoon exercises will be held at the new site, with

short addresses by Professors Warren, Dwight and Shattuck and Mr. Coolidge, the architect. In the evening a reception will be given at the Boston Medical Library. On Wednesday morning there will be exercises at Cambridge, which will include addresses by President Eliot and Professor Welch, of the Johns Hopkins University, and the conferring of honorary degrees. In the afternoon the triennial banquet of the Harvard Medical Alumni Association will be held in Memorial Hall.

The Johns Hopkins University announces the establishment of advanced courses in applied science. They aim to present the most recent advances of the several sciences from the point of view of theory and in their special bearing on industrial applications, and are designed to meet the demand for a specialized scientific equipment exceeding that indicated by the usual collegiate or engineering degree. Particular attention will be paid to the results of research and to improvements in methods, as reported in the current scientific literature. Complete laboratory facilities are offered to engineers and others who desire to prosecute research along particular lines. The courses are intended for the following classes of students: (*a*) Graduates in engineering or science who wish to extend their equipment in special directions; (*b*) engineers desirous of knowing the present state and trend of research in their subjects; (*c*) those wishing to prosecute some special experimental research; (*d*) those wishing to attend special courses in applied science.

An Italian-American educational alliance has been established for the exchange of lecturers and professors between the two countries and the improvement of their educational relations. The arrangements have been made in Italy by Dr. Joseph S. Kennard, who especially represented the University of Pennsylvania.

It is reported that at the meeting of the Russian Council of Ministers, held on August 21, it was decided to appoint a commission to draw up a bill providing for universal primary education, to be submitted to the council of the empire and the duma at the beginning of the next session. The council also decided that it was imperatively necessary to increase the salaries of primary teachers and to build more schools, for which purpose it assigned a grant of 5,333,000 roubles, chargeable to next year's budget. A commission sitting under the presidency of the minister of education has recommended the reopening of the universities, under practically the same conditions as were vainly tried last autumn, an autonomous government by a professorial council.

Professor Dugald C. Jackson, head of the department of electrical engineering at the University of Wisconsin, has been elected professor of electrical engineering and head of the electrical engineering department in the Massachusetts Institute of Technology, as the successor of Dr. Louis Duncan, who resigned about a year and a half ago.

Dr. Thomas E. McKinney, professor of mathematics and astronomy at Marietta College, has been called to Wesleyan University; Dr. Henry L. Coar, instructor in the University of Illinois, has been appointed assistant professor of mathematics in Marietta College, to succeed Professor McKinney.

The University of Southern California at Los Angeles has made the following promotions and appointments: Miss Nelle Lancaster, instructor in biology, to become assistant professor of zoology; Edward A. Henderson, instructor in chemistry, to become assistant professor of pharmaceutical chemistry; Miss Florence E. Durkee (A.B. Stanford University), appointed fellow in botany.

Dr. Gustav Hauser, of Erlangen, will succeed Professor G. E. von Rindfleisch as professor of pathology at Würzburg.

Dr. Robert Wollenberg, professor of psychiatry at Tübingen, has been called to a similar chair at Strasburg.

Dr. Ludwig Rhumbler, of Göttingen, has been appointed professor of zoology in the School of Agriculture at Hanover.